Space Weather Technical Forecast

Issued on Monday, 21 November 2022 at 00:32 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of isolated G1/Minor Storms, mainly day 1 (21st), before reducing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low in the last 24 hrs, with an isolated C3 flare at 20/0609 UTC. This originated from AR3150 (Beta/Dai), which is currently transiting toward the northwest limb, and showing steady decay. The most notable growth has been observed in AR3149 (Beta/Dai) in the northeast quadrant, with several small umbrae having recently developed. The remaining two bi-polar groups, in the southeast quadrant, have changed little in recent imagery, and producing only minor activity. No significant returning active regions are due this period. No Earth directed CMEs were seen in available imagery. A CME launched off the west limb, following the C3 flare, has been modelled and is awaiting results. However, it looks directed well off the Sun-Earth line and rather slow, so no significant impacts are anticipated.

Solar Wind / Geomagnetic Activity: Solar winds measured by ACE and DSCOVR at L1 were in the range 310-350km/s until around 20/1800 UTC, when an increase was observed to 400-420km/s. Density showed a slow rise from below average to just above average values with peak 22 ppcc around 20/1645 UTC. The total interplanetary magnetic field (IMF) Bt, showed a similar profile to density with peak around 12nT. The north-south component, Bz, was weak and mostly positive (northward) until around 20/1500 UTC, after which larger fluctuations were observed +/-9 nT. The phi angle was predominantly negative (towards the Sun) throughout. Geomagnetic activity was Quiet (Kp 0 to 2), with one Unsettled interval 20/18002100 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2 MeV) at GOES16 was at predominantly Background, with a peak of 219 pfu at 20/1805 UTC. Electron fluence levels remained well below Active (1e8 integrated pfu) levels. Observed fluence at 21/0001 UTC was 1.75e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to continue Low, with a slight chance for isolated Moderate flares.

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Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, however glancing interactions from passing CMEs are possible on day 2 (22nd).

Otherwise, coronal hole 46/- influence is expected through day 1 (21st) and into day 2 (22nd), with solar wind speeds potentially increasing further, although the peak magnitude is low confidence. Days 3 and 4 (23rd and 24th) should then see gradually waning effects from CH46. At the end of day 4 (24th) another small coronal hole 47/+ may begin to move into a geo-effective position. Geomagnetic activity is anticipated to be occasionally Unsettled on day 1 (21st) and into day 2 (22nd), with a chance of Active, and slight chance of an isolated G1/Minor

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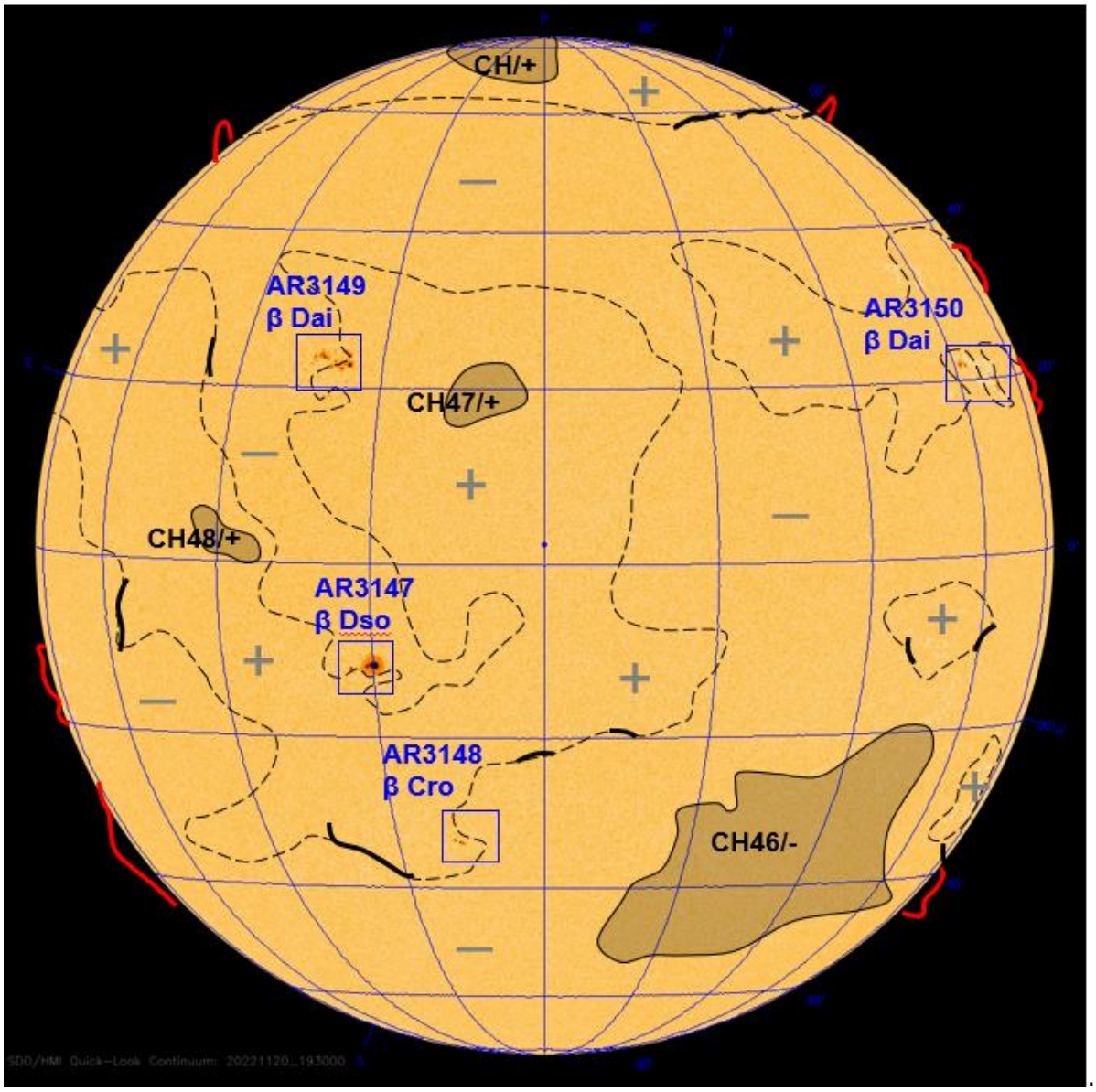
Storm interval, due coronal hole influence. Conditions should then ease to mostly Quiet conditions with isolated Unsettled intervals from day 3 (23rd).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at Background levels throughout. Electron flux is forecast to be at Background to Moderate levels, but with a Chance of rising to perhaps High on diurnal peaks later in the period. Fluence values are expected to remain below the Active (1e8 integrated pfu) threshold throughout, but with a likely upward trend through the period.

Figure 1. Solar Analysis Valid 20/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no significant Earth-directed CMEs currently forecast, however slight glancing impacts are possible on day 2 (22nd), due to CMEs from the filament eruptions on the 19th passing north of Earth but close by. A further CME launched off the west limb, following a C3 flare, has been modelled and is awaiting results. However, it looks directed well off the Sun-Earth line and rather slow, so no significant impacts are anticipated.

Solar winds have risen just into slightly elevated levels since 20/1800 UTC, most likely due to some interaction with the fast winds from negative polarity coronal hole 46. Further influence is expected through day 1 (21st) and into day 2 (22nd), with wind speeds potentially increasing further, although the peak magnitude is low confidence. Days 3 and 4 (23rd and 24th) should then see a gradual waning influence of CH46. At the end of day 4 (24th) another small coronal hole 47/+ may begin to move into a geo-effective position.

Geomagnetic activity is anticipated to be occasionally Unsettled on day 1 (21st) and into day 2 (22nd), with a chance of Active, and slight chance of an isolated G1/Minor Storm interval, due coronal hole influence. Conditions should then ease to mostly Quiet conditions with isolated Unsettled intervals from day 3 (23rd).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None expected.

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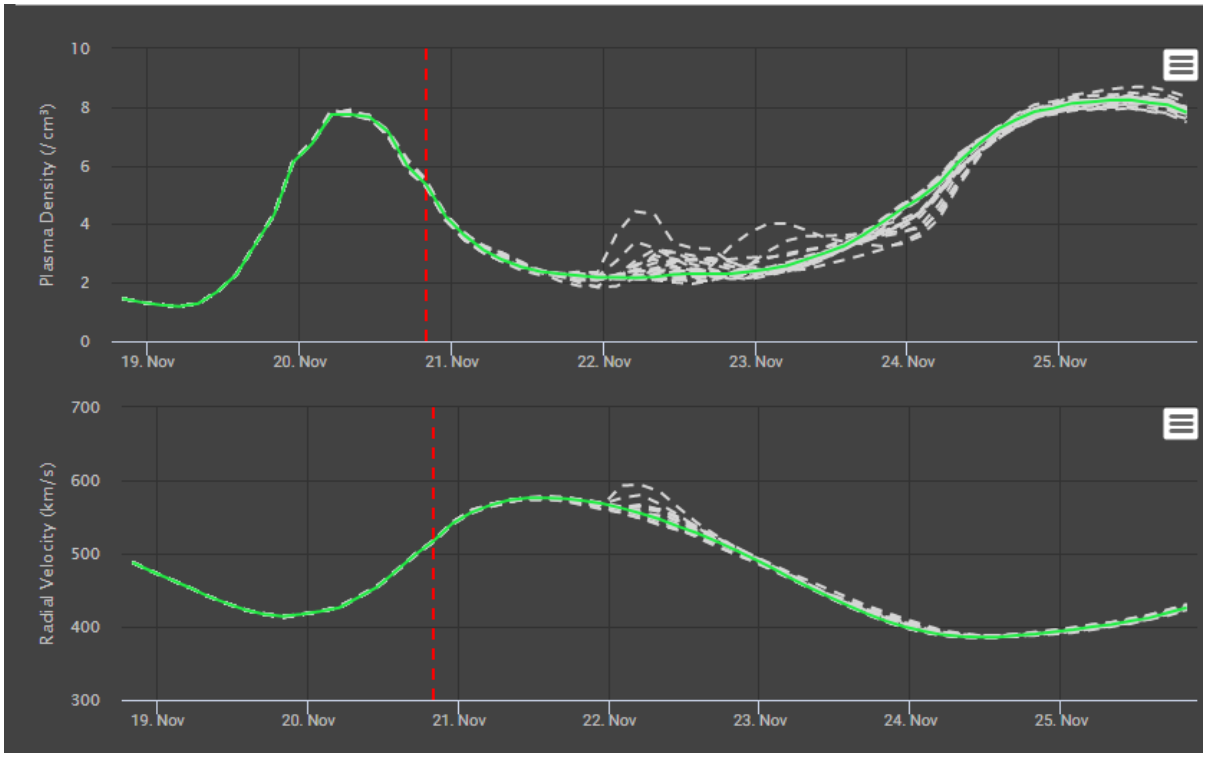
Figure 2: Enlil ensemble showing increase in solar winds due to coronal hole 46/-, with a few ensemble members indicating possible slight CME impacts on 22nd.



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Radio Blackouts - X-Ray Flares:

Solar activity was Low in the last 24 hrs, with an isolated C3 flare at 20/0609 UTC. This originated from AR3150 (Beta/Dai), which is currently transiting toward the northwest limb, and showing steady decay. The most notable growth has been observed in AR3149 (Beta/Dai) in the northeast quadrant, with several small umbrae having recently developed. The remaining two bi-polar groups, in the southeast quadrant, have changed little in recent imagery, and producing only minor activity. No significant returning active regions are due this period.

Solar activity is expected to continue Low, with a slight chance for isolated Moderate flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	15	15
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background and expected to persist at this level.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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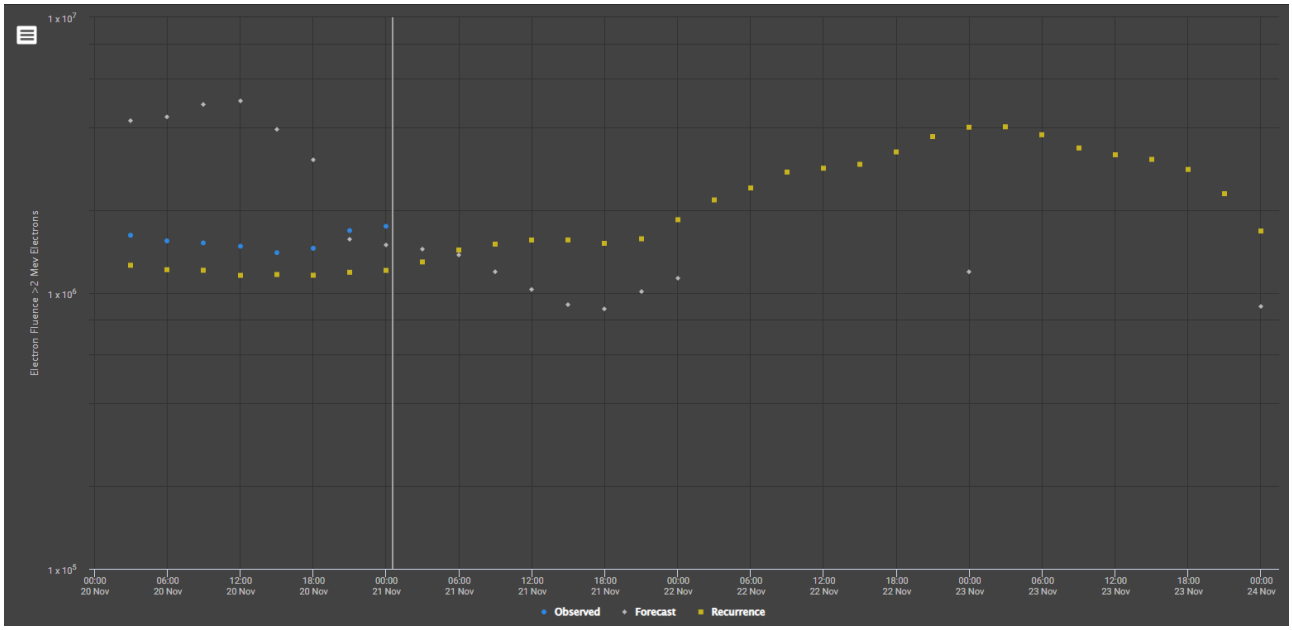
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES16 is at mainly Background, briefly Moderate levels. The likely solar wind enhancement on day 1 into day 2 (21st and 22nd) has the potential to increase the electron content in the Van Allen belts, although these are likely to initially be compressed inside of GEO. As solar wind pressure eases later in the period, the observed flux is likely to rise, perhaps reaching Moderate to diurnally High levels. The strength of any response is very low confidence however, with no significant increase in flux observed on the previous pass of this coronal hole, 27 days ago.

The associated 24-hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold, but with a likely upward trend through the period. REFM is currently giving good guidance, however persistence looks a better guide regarding expected trends in the forecast period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	15	25
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: MOSWOC REFM



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